

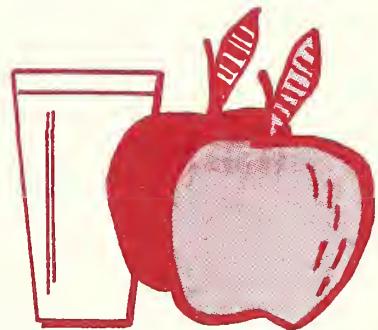
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Recent Developments in the Production and Marketing of

APPLE JUICE and CIDER

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ECONOMIC ANALYSIS
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Division of Marketing and Utilization Sciences

Federal Extension Service

U. S. Department of Agriculture

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FOREWORD

This bulletin has been prepared as a reference work for Extension and research personnel. It should also be of interest to apple industry leaders at both the grower and processor level.

The report is a companion to Recent Developments in the Production and Marketing of Apple Sauce and Slices, July 1965 (71 pp.).

Single copies of each report may be obtained by writing the Division of Marketing and Utilization Sciences, Federal Extension Service, U. S. Department of Agriculture, Washington, D. C.

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RECENT DEVELOPMENTS IN THE PRODUCTION
AND MARKETING OF APPLE JUICE AND CIDER

by

Dana G. Dalrymple and Irvin C. Feustel*

I. INTRODUCTION

Apple production is expected to expand sharply in the United States within the next few years. As it does, there will be an increasing need for processing outlets. Yet there is some question as to whether the processing market will be able to absorb all the apples that the future promises.

Moreover, the problem will contain qualitative aspects. These will center about varieties and processing facilities. Despite a swing in consumption from the fresh to the processed form, plantings lean heavily toward what are presently considered "fresh" varieties. Furthermore, many of these plantings are in areas of the country which are relatively deficient in processing facilities.

In light of these divergent trends, there is apt to be an increased interest in apple juice and cider. Both can be made from "fresh" varieties. Neither requires very elaborate processing facilities. But unless prices for apples for these purposes can be increased above current levels, growers are unlikely to regard this outlet as very promising.

Under these circumstances, it seems desirable to take a close look at current developments in the production and marketing of apple juice and cider to see what promise they hold for the future. We shall concentrate on the years since 1960.^{1/} During this period, there have been some areas of significant technological advance - and some of little progress.

But before we proceed, it would be well to pause and clarify terms. Juice is considered to be the pasteurized product of a commercial firm which is packed under vacuum in sealed tins or glass bottles. Cider is considered to be the unclarified, unpasteurized, and unfermented product of a farm mill that is packed in unsealed glass or paper containers; chemical

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1/For a discussion of developments prior to 1960, see:

--Dana G. Dalrymple, Marketing Fresh Apple Juice and Cider, University of Connecticut, Department of Agricultural Economics, Progress Report 27, November 1958, 118 pp. Supplement, August 1959, 32 pp.

--Dana G. Dalrymple, Market Potentials for Apple Juice and Cider, Michigan State University, Department of Agricultural Economics, Ag. Econ. 804, December 1960, 31 pp.

(Copies of all three reports may be obtained from the author.)

preservatives may be added and/or the cider may be preserved by refrigeration. Where cider is packed in cartons and refrigerated, it is sometimes referred to as fresh juice.^{2/}

With these rough definitions in mind, we turn first to the matter of economic statistics concerning the apple juice and cider industry.

II. ECONOMIC STATISTICS

In an attempt to provide some idea of the economic setting in which the production and marketing of juice and cider takes place, we start with a brief analysis of available statistics.

Unfortunately, it must be admitted that this venture will, at times, seem more frustrating than enlightening. The sad fact is that there is relatively little economic information available on the apple juice and cider industry. While improvements have been made in the technical aspects of juice production and marketing over the past few years, many of the data which would be desirable for an economic study are still not available. The problems involved will become evident in the following sections.

We will examine the available information at the farm, processor, and consumer level.

A. Farm Level

1. Utilization

There are no data providing a clear-cut indication of the quantity of apples used for apple juice and cider in the United States. Under the Department of Agriculture reporting system, juice and cider are included with "other" processed apples. The official definition of this term is

Mostly crushed for vinegar, cider, and juice.
For some States, some quantities canned, dried
or frozen are included to avoid disclosure of
individual operations.^{3/}

As a result of a special study made for the 1962 crop, however, it was estimated that approximately 85 percent of the "other" category represented

^{2/}The problems of defining juice and cider are discussed in greater detail by Dalrymple, op. cit. (1958), pp. 52-53.

^{3/}Fruits, Noncitrus, by States, 1961 and 1962, U. S. Department of Agriculture, Statistical Reporting Service, July 1963, p. 8. Otherwise, canned, dried, and frozen apples are published separately and not included with "other" processed apples.

apples that were crushed. This indicated that of the 15.8 million bushels reported in "other" for the U. S., about 13.5 million bushels were crushed.^{4/}

The crushed category, of course, is still too broad, for it includes an unknown (but probably decreasing) quantity of apples used for vinegar. It is not possible to pull the vinegar figure out of the Department of Agriculture data because only the aggregate crushed figure is reported by the States.^{5/} Estimates from the National Apple Institute, however, suggest that about 20 percent of the total U. S. crush during the 1954-58 period was actually used for vinegar.^{6/} A more recent estimate by a leading processor would place the U. S. figure at about 2.5 million bushels, or about 18.6 percent of the crush.^{7/} If we arbitrarily cut this a bit and assumed that vinegar took 18 percent of the total crush in 1962, we would have a residual figure of 11 million bushels used for juice and cider.

Just how much of this quantity was used for juice and how much for cider is another thorny question. Estimates gathered in an earlier publication indicated that during the 1957 and 1958 seasons, production of cider in the U. S. was slightly greater than that of juice.^{8/} This, in turn, suggests that we might assume that the utilization of apples may have been about equally divided between the two uses in 1962. In other words, somewhere around 5.5 million bushels may have been utilized for each purpose. This in turn would have represented some 4.4 percent of the crop in each case.

^{4/}The figure for New York alone was 3.0 million bushels ("Statistics Relative to the Apple Processing Industry in New York State," New York Crop Reporting Service, Albany, June 1963, p. 2).

^{5/}Michigan, however, has unpublished data that suggest that from 17.5 to 18.9% of the 1962 crush was used for vinegar (letter from G. A. Swanson, Michigan Agricultural Statistics Reporting Service, Lansing, April 1, 1964).

^{6/}Dana G. Dalrymple, "Economic Aspects of Apple Marketing in the United States," Michigan State University, Department of Agricultural Economics, Ph. D. dissertation, 1962, p. 123. This figure represents a decline from a level of 60% during the 1947-51 period.

^{7/}From a discussion with Wilkie Hunt, Vice President of National Fruit Product Co., Winchester, Virginia, April 1, 1964 (also a letter, same date). Hunt estimates that of the approximately 50 million gallons of apple-based vinegar produced in the U. S., about 80% was obtained from cores and peels and 20% from whole apples (assuming 40% of cores and peels used for vinegar; a smaller percentage would raise the portion provided by whole apples). Assuming a yield of 4 gallons per bushel, a press of 10 million gallons would suggest a utilization of 2.5 million bushels.

^{8/}Dalrymple, op. cit. (1959), p. 3. It is difficult to work back from actual production of apple juice because an unknown quantity of juice is pressed from cores and peelings.

2. Prices

Much the same problem that exists in the utilization sphere carries over into prices. Department of Agriculture figures come no closer than an average season price for "other processing." The figure was \$1.41/cwt. for 1962.^{9/} Again, a special tabulation was made which indicated that the average price for apples for crushing was \$1.32/cwt.^{10/} If apples are purchased exclusively for juice, a slight premium is often paid - for the apples may be expected to be graded. The price for cider apples, however, appears to be little higher than that for apples purchased specifically for vinegar. In any case the overall crushing price should be fairly representative, if a bit low.

3. Value

In view of the difficulty, noted above, of obtaining information on utilization and prices, only a very rough estimate of the farm value of juice and cider apples can be made. The simple procedure of multiplying the adjusted utilization figure derived in Section 1, by the adjusted price noted in Section 2, suggests a farm value of nearly \$7 million in 1962. This figure, if reasonably correct, would represent about 2.9 percent of the total farm value of sales of apples.^{11/} While a relatively small amount by this measure, it is not insignificant and can be expected to grow.

B. Processor

At the processor level, we have considerably more accurate and detailed information on apple juice production; unfortunately the situation for cider is no better.

1. Apple Juice

The annual pack of single-strength apple juice is well reported by the National Canners Association.^{12/} Their data, however, do not indicate the pack of baby food juice or frozen concentrate, or the quantity used in blends. When their figures on the number of cases packed are converted to a volume basis, it appears that production during the 1962 season totaled 28.6 million gallons. Over the past ten years, production has about doubled (see Table 1).

^{9/}"Noncitrus Fruit Prices," Supplement No. 1 to Agricultural Prices, U. S. Department of Agriculture, Statistical Reporting Service, June 1963, p. 4. Prices showed no marked trend over the previous ten year period, but did average somewhat lower (\$1.29/cwt.) (Prices Received by Farmers; Noncitrus Fruits, 1944-58, U. S. Department of Agriculture, Statistical Bulletin No. 322, September 1962, p. 22).

^{10/}The average price paid in New York was \$1.11/cwt. during the same season ("Statistics Relative . . .," loc. cit.).

^{11/}The total value of apple sales at the farm level in 1962 was \$245,319,000 (Crop Values, U. S. Department of Agriculture, Statistical Reporting Service, December 13, 1963, p. 26).

^{12/}Canned Food Pack Statistics, 1962, National Canners Association, Washington, June 1963, p. 78.

Table 1. U. S. Production of Canned Apple Juice
(excludes baby food & blends)

<u>Season</u>	<u>Production</u>
1953-54	11,640,000 gals.
1954-55	15,690,000
1955-56	12,927,000
1956-57	15,578,000
1957-58	17,054,000
1958-59	20,175,000
1959-60	25,269,000
1960-61	24,028,000
1961-62	26,398,000
1962-63	28,567,000
<hr/>	
1963-64	32,952,000

Source: Computed from statistics reported in Canned Food Pack Statistics, 1962, National Canners Association, Washington, June 1963, p. 78.
Conversion on the basis of one case of No. 2 cans = 3.853125 gallons.

Production by region has varied by season, but over the last five years about 25 percent was produced in Pennsylvania and Virginia, 15 percent in Michigan, 17 percent in California, and 43 percent in other States (the most important of which was New York).^{13/} About 45 percent of the pack was in tin, 52 percent in glass, and 3 percent miscellaneous; little trend in containers was apparent.

2. Cider

No data are presently available which could be used to directly estimate cider production. Indirect measures suggest, as previously noted, that for the 1954-58 period production of cider was slightly in excess of that of juice.^{14/} If it can be assumed that juice and cider production are about equal, this would place the 1962 cider figure at about 28.6 million gallons.

3. Total

If we add the foregoing estimates for canned juice and for cider, and make an arbitrary allowance for baby food, concentrate and blend use, we

^{13/}The New York figure probably slightly exceeded that for California over the period. Data for the 1963 season suggest that the New York portion was from 19 to 20% (calculated from information provided by W. D. Tyler, New York State Canners and Freezers Association, Rochester, March 26, April 1, 1964).

^{14/}Dalrymple, loc. cit. (1959). Excludes quantities used for vinegar.

find it possible to come up with a figure of about 60 million gallons for the 1962 season.

Such a figure appears possible, and possibly even conservative, when some detailed production figures from New York are examined. In 1962, 19.3 million gallons of juice and cider were reported pressed in New York.^{15/} If we assume that 18 percent of the total press was used for vinegar we still have a figure of 15.8 million gallons, exclusive of what may have been lost for various reasons (spillage, spoilage, etc.). But if the final New York juice and cider figure were only, say, 14 million gallons, it still would be 23 percent of the U. S. estimate noted earlier. Since the proportion of juice and cider packed in New York is unlikely to be this high,^{16/} the U. S. estimate of 60 million gallons might well be conservative.

There is another crude way of checking. This is by making use of the previously cited estimate of 11.0 million bushels of apples used for juice and cider in the U. S. Data from New York for the past five years suggest that for every bushel of apples used for cider and juice, 6.95 gallons of juice and cider were pressed.^{17/} This rate of extraction is twice as high as the traditional figure, but is raised because of the large quantities apparently pressed from the cores and peels. If the figure is reduced to 5.5 for the U. S. (to allow for a smaller use of cores and peels in other areas) and multiplied by the 11.0 million bushel figure noted earlier, we still have the U. S. production figure of 60 million gallons of juice and cider.

It is to be hoped that more detailed statistical reporting will be adopted in the future which will eliminate the need for such indirect and unprecise estimating procedures.

C. Consumer

As in the previous spheres, there are limited economic data on apple juice and cider available at the consumer level.

The Department of Agriculture consumption figures for apple juice are based on the National Canners Association's statistics on the pack of canned apple juice (noted previously). As such, of course, they overlook the quantities of juice consumed as baby food, as frozen concentrate and in blends. Therefore, they are minimal figures. Even so, they may be representative. The product or retail weight figures (Table 2) indicate that average per capita consumption in 1962 was 1.05 pounds. This was about 8.2 percent of all pure canned juice consumption, and about twice as high as the 1952 figure.^{18/}

^{15/}"Statistics Relative . . .," op. cit., p. 3.

^{16/}See fn. 13.

^{17/}"Statistics Relative . . .," op. cit., pp. 2, 3.

^{18/}The Fruit Situation, U. S. Department of Agriculture, Economic Research Service, August 1963, p. 29.

Table 2. U. S. Per Capita Canned Juice Consumption
product-weight equivalent
(excludes frozen)

Calendar Year	Apple	All Juices	Apple as Prop. of All
1952	0.54 lb.	13.77 lb.	3.9%
1953	0.51	13.55	3.9
1954	0.71	13.15	5.4
1955	0.54	12.88	4.2
1956	0.66	13.86	4.8
1957	0.68	14.10	4.8
1958	0.77	14.40	5.3
1959	0.79	12.86	6.1
1960	0.90	13.86	6.5
1961	0.95	13.09	7.3
1962	1.05	12.85	8.2

Source: The Fruit Situation, U. S. Department of Agriculture, August 1963, p. 29.

By comparison it might be interesting to note that the average per capita consumption of juice by the Michigan State Consumer Panel in Lansing during the 1953-57 crop years was 0.75 lb. (excluding baby juice). The comparable average for the U. S. for the 1953-57 calendar years was 0.62 lb. The two figures check out quite well considering that Lansing is located in a large apple-producing State.¹⁹

Needless to say, there are no USDA estimates of cider consumption. The Consumer Panel data indicated an average per capita consumption of 1.76 lb. But because of Lansing's location, a particularly high cider figure might be expected.

Total per capita consumption of apple juice and cider by the panel, then, was about 2.57 lb. Further details on purchases are provided in Table 3.

Analysis of seasonal trends in prices and purchases of juice and cider indicated the following:²⁰

Juice: Prices were fairly uniform, though they tended to be lower and more variable from August to October than later in the season. Purchases showed very wide variation from year to year but it appeared that there was a drop from July to a seasonal low in September, then an increase, then

¹⁹/Dana G. Dalrymple, Consumer Purchases of Fresh and Processed Apples, Michigan State University, Department of Agricultural Economics, A. E. 806, January 1961, pp. 3-5.

²⁰/Ibid., pp. 12, 13.

Table 3. Average Annual Per Capita Apple Purchase Data
Michigan State Consumer Panel
Lansing, Michigan
1953-1957 Crop Years

	<u>Juice</u>	<u>Cider</u>	<u>Total</u>
Total acquisitions ^{1/}	0.80 lb.	1.76 lb.	2.57 lb.
Average purchase	0.79 lb.	1.66 lb.	2.45 lb.
Average price/lb. ^{2/}	10.32¢	7.33¢	
Average expenditure	9.76¢	12.11¢	21.87¢
Proportion of all apple purchases (lbs.)	2.58%	5.37%	7.95%
Proportion of all apple expenditures (¢)	2.88%	3.61%	6.49%

1/Including baby food, gifts, and home prepared.

2/1954-1957 crop years.

Source: Dana G. Dalrymple, Consumer Purchases of Fresh and Processed Apples, Michigan State University, Department of Agricultural Economics, A. E. 806, January 1961, pp. 3-5.

another drop in late November and early December, and then more or less a gradual increase through the rest of the season. The early season trends would seem to reflect the influence of heavy marketings of cider.

Cider: Prices increased through the first three weeks of September and were then rather constant until December, when they began to decline. Concurrently, nearly all the purchases were made in the September-December period with a seasonal peak in mid to late October (when 44 percent of the purchases were made in a three-week period). Cider was unique in that early in the season, prices increased as quantity increased, with the reverse true later in the season.

It may be of interest to note in closing that if an average price of 8.8¢/lb. existed for juice and cider over the U. S. in 1962, the retail value of a total production of 60 million gallons would have been about \$42 million.

III. CANNED JUICE^{21/}

In this and the following two sections, we will first consider recent developments in processing, and then turn to an examination of marketing practices.

21/This section includes commercially processed juice packed into cans or bottles.

A. Processing

A satisfactory process for the extraction of apple juice must give adequate yields of juice with a minimum of suspended solids. It must be applicable to apples having a wide range of pressing characteristics (from meaty and soft to crisp and starchy) due to differences in variety, maturity and condition. The pressing equipment should have minimum labor requirements for operation and should present no problem of sanitation.

Many processors still regard the familiar rack-and-cloth hydraulic batch press as the best all-around type of pressing equipment, but admittedly this has a high labor cost and is difficult to clean.

Recent innovations in the processing of canned juice have resulted mainly from efforts to improve juice extraction techniques. There are two main types (1) batch pressing and (2) continuous extraction.

1. Batch Pressing^{22/}

A Canadian firm is reported to be using a Willmes type press on hammer-milled pulp blended with rice hulls. This equipment consists of a cylinder with a nylon cloth forming its inner surface. A stainless steel screen supported by an outer rib construction serves as a backup for the cloth. Pressure is exerted on the pulp-rice mixture by means of an internal rubber bag running the length of the cylinder, into which compressed air is pumped. The juice is thereby forced out through the nylon cloth and subsequently treated with pectinase enzyme to hydrolyze pectin and aid in clarification. The above-mentioned plant allows the suspended solids to settle and then decants to separate partly clarified liquid prior to filtration. Other plants using the Willmes press have enough filter capacity to permit them to filter the enzyme-treated juice directly from the tanks without settling.

2. Continuous Extraction

a. USDA Developments^{23/}

Research on the development of a continuous or semi-continuous system for apple juice extraction is in progress at the Western Regional Research Laboratory located at Albany, California. Development of a two-stage dejuicing system involving a basket centrifuge and a screw press was reported at the 1964 annual convention of the Institute of Food Technologists in

^{22/}"Develop 3 New Juice Extraction Processes," Food in Canada, January 1964, p. 30. A more detailed description of the Willmes press is given in Food Technology, April 1964, p. 116.

^{23/}E. Lowe, W. E. Hamilton and A. I. Morgan, Jr., "Dejuicing of Apples," U. S. Department of Agriculture, Agricultural Research Service (Western Regional Research Laboratory).

Washington, D. C. In this system, apples are first passed through a hammer-mill. Juice from the hammermilled pulp is partially extracted in a basket centrifuge. Juice extraction is completed by pressing the centrifuged pulp in a vertical screw press. One-half of one percent cellulose pulp was used as a pressing aid and was found adequate for most apples tested.

This process, which lends itself to full automation, was reported to give juice with yields and suspended solids contents, using Western apples (particularly Washington Red Delicious), that were significantly improved in most cases over those obtained from a rack-and-cloth press. Early mid-season and late season fruit was included in the work reported to date.

b. Commercial

Commercial experience with a continuous processing procedure for juice has been limited. Of the two eastern processors known to have worked on a continuous process, one appears to have worked out an acceptable system, while the other is not satisfied yet. The first processor has perfected a continuous processing technique that cuts oxidation to a minimum; the product has been successfully marketed for several seasons. Conversely, the other processor reports --

We have spent many years and large sums of money in an endeavor to manufacture apple juice on a single extractor, but all of the experiments that we tried turned out to be unsatisfactory. We have combinations of centrifuges, vacuum, extractors, disintegrators, etc., but we have not been able to work out the so-called utopia of a single operation.

He adds, however, that the combination of these machines does provide a technique which cuts oxidation substantially and produces a juice which is superior to that turned out with the traditional methods.

Presses have been completely eliminated in a process used by a Paw Paw, Michigan firm. Basically, the method involves (1) pulping the fruit in a disintegrator; (2) treatment of the slurry with a depectinizing enzyme to impede jelling action of the pectin, to release juice from pulp, and to prevent subsequent clogging of filter mediums; (3) flash-heating at 170-190° F. to inactivate pectinase enzyme; and (4) clarification of juice with a rotary, vacuum-precoat filter.²⁴

A plant at Sebastopol, California employs two centrifuges for extraction of juice from a hammermilled slurry. Juice recovered in the first centrifuge is passed through the second for removal of suspended solids and partial clarification. Filter aid is then added and the juice is filtered by a rotary vacuum-drum filter followed by a polishing filtration. The "press cake" from the centrifuge is pressed in a vertical continuous press.²⁵

²⁴/John A. Murch and Norman F. Murch, "Simplified Juice Recovery," Food Engineering, February 1964, pp. 42-43.

²⁵/W. C. Cruess, "Apple Juice Production in California," The Canning Trade, May 7, 1962, p. 8.

In another process recently placed on the market, extraction is done by a horizontal belt vacuum unit.

B. Marketing

There have been few changes in the marketing of canned apple juice in recent years. The biggest innovation has been the introduction of a number of blends of apple juice with other juices.

In order to gain a clearer impression of the market position of both pure and blended juices, a survey of availability and prices was conducted in 16 cities scattered throughout the U. S. in March 1964.^{26/} In each city, State Extension workers gathered information from four chain stores; in the Washington, D. C. area, eight chains were included. Observations were limited to quart and 46-ounce containers - the two most popular sizes. In addition, several other studies were noted.

1. Pure Juice

a. Availability and Prices

Regular apple juice, as might be expected, enjoyed a wide distribution. It was carried in every store visited; in fact, most stores carried about three blends - two of the quart size and one of the 46-ounce size.^{27/}

Prices for the quart container varied from 23 to 43¢, averaging 32.3¢; the 46-ounce cans varied from 30 to 49¢, and averaged 40.6¢.^{28/} Certain well-known brands averaged higher, while private labels ran lower. Rounding of the overall prices would suggest, then, an average of 32¢ per quart and 41¢ per 46-ounce can.

By way of comparison it may be noted that the average price of the 46-ounce can in nine New England chains during the 1958-59 season was 31¢.^{29/} Since apple juice prices do not vary much during the season,^{30/} the obvious

^{26/}Cities covered in the survey included: the Washington, D. C. area; New York, N. Y.; New Brunswick, N. J.; State College, Penn.; Pontiac, Mich.; Lexington, Ky.; Raleigh, N. C.; Homestead, Fla.; Columbus, Ohio; Lafayette, Ind.; Chicago, Ill.; Little Rock, Ark.; Corvallis, Oreg.; Berkeley and Riverside, Calif.; Tucson, Ariz.

^{27/}The average was slightly higher in California and in the Washington, D. C. area. Some stores in California also carried apple nectar, carbonated apple juice, and apple juice drink (an apple ade was noted in a N. J. store).

^{28/}The average figures were pulled up by the high prices in California - 36.7¢/qt. and 43.8¢/46-oz. can.

^{29/}Dalrymple, op. cit. (1959), p. 6. The New England price might well have been slightly less than that for the country as a whole.

^{30/}Dalrymple, op. cit. (1961), p. 12, 13.

suggestion is that there may well have been a distinct rise in apple juice prices at retail over the past five years. It is unfortunate that we do not have more authoritative and comprehensive data to corroborate this arresting point.

b. Sales Volume^{31/}

An indication of apple juice sales nationwide and by region is provided in a comprehensive study of canned fruit and vegetable juice sales conducted by Chain Store Age. A survey of 2,519 chain supermarkets throughout the country in 1962 indicated that apple juice ranked fourth out of 18 juices and juice drink blends in terms of proportion of total department sales (6.3 percent).^{32/} However, apple juice ranked third in terms of total department gross profit (6.9 percent). The average gross margin (26.9 percent) was the third highest. Apple juice sales in 1962 (6.3 percent) had climbed perceptibly from their 1960 level (5.7 percent).

Sales of apple juice varied sharply by region (see Table 4). They were easily highest on the Pacific Coast, followed by the New England States and the South. Sales appeared to be lowest in the Mid-Atlantic and Midwestern States. Just why sales should be so high on the West Coast - particularly since California prices were about 10 percent above those elsewhere - and relatively so low elsewhere, is not clear.^{33/}

Table 4. Canned Apple Juice Sales Performance by Regions
(2,519 chain stores, average sales of \$20,000/week)

Region	Sales Within Juice Dept.		Weekly Case
	Rank	Percent of Sales	Movement
New England	6	5.6	4.3
Mid-Atlantic	14	2.5	2.5
South	6	7.3	3.6
Midwest	14	2.8	1.4
Pacific	2*	13.3	7.0
United States	5	6.3	

*The sales percentage was only 0.1% below first-place tomato juice, while the movement was 0.2 cases greater.

Source: Chain Store Age, Mid-July 1963 - Grocer's Manual Issue, pp. 143-145.

31/"Canned Juice," Chain Store Age, Mid-July 1963 - Grocer's Manual Issue, pp. 143-145.

32/All juice drinks made up 30.4% of total juice sales; instant drinks accounted for 3.5% of the total.

33/Perhaps apple juice is substituted for cider to some extent on the West Coast. Otherwise it would appear that demand is stronger than elsewhere in the country.

2. Blends^{34/}

a. Availability and Prices

The Extension retail survey indicated that apple juice has been commercially blended with a number of other fruit juices. The specific blends noted were: (1) apple-grape, (2) apple-cherry, (3) apple-cranberry, (4) apple-raspberry, (5) apple-prune, (6) apple-apricot-prune, (7) apple-cherry-berry, (8) apple-orange-pineapple-apricot-prune, and (9) as a base for fruit punch.^{35/}

Of the group, the apple-grape blends are far most prevalent, followed by the apple-apricot-prune, and the five-fruit blend. One firm led in the distribution of all three - although sharing the apple-grape with one other large producer.^{36/} Distribution of the other blends was spotty, though good in the Washington, D. C. area. Several producers of each of the other blends were noted; the exception being the apple-cranberry and apple-raspberry juices which are evidently only produced by one firm.

Prices for the blends varied even more widely than for the pure juices. Averages, however, may be summarized as follows:

Table 5. Average Apple Blend Prices at Retail*
16 Cities, March 1964

Blend	Price per	
	Quart	46-ounce
1. Apple-grape	34.1¢	39.7¢
2. Apple-cherry	35.0	--
3. Apple-cranberry	--	45.5
4. Apple-raspberry	--	46.0
5. Apple-prune	38.5	--
6. Apple-apricot-prune	49.0	--
7. Apple-cherry-berry	--	36.4
8. Apple-orange-pineapple-apricot-prune	34.0	--

*The sample number for the apple-grape blends (particularly the quart sized unit) was much larger than for the others. A much more precise and comprehensive study would be required before it could be said that the prices accurately represented average U. S. prices.

^{34/}Information on studies of various blends is provided in Section VII/B. Canadian experience is briefly noted in Section VIII/A.

^{35/}In addition, an apple-boysenberry blend was noted in a California store.

^{36/}The latter plans to complete national distribution by the end of fiscal year 1964. The 1963 annual report of the firm indicated that the blend was "making satisfactory progress in all areas where it has been in distribution." A 24-ounce can was also being used in Oregon in March 1964.

It was noted that the prices for the quart units of the grape blends approximated each other very closely. Prices of the two leading 46-ounce units, however, varied sharply. The reasons for the latter difference are probably largely related to differences in quality - measured in this case by proportion of pure juice.

b. Juice Drinks^{37/}

In the foregoing section, the apple blends were referred to as juice blends. In one sense this is true, but in another it is not. That is, while apple juice (often reconstituted) is indeed mixed with the juices of other fruits, the resulting blend is usually diluted with water and sugar.^{38/} Flavoring and coloring may also be added.

The amount of dilution varies widely, but it appears that the total level of juices may generally be no more than 35 percent. There are, of course, variations; the packer of one of the 46-ounce grape apple blends has a total level of nearer 50 percent, while some others would appear to be less than 35 percent. Under these conditions, the level of apple juice appears to average only 15 to 20 percent, going as high as 30 percent in the case noted above and probably lower for some others.^{39/}

With these dilution levels, then, most of the resulting blends are no longer pure juice blends. There is no precise term, however, for just what they are. Many are labeled "juice drinks," but there are numerous variations.

The total blend picture, therefore, is an extremely mottled one: a variable but generally rather low level of juice, and a wide range of names for the product. If the consumer is, as a result, a bit confused as to what is what, it is not without good reason.^{40/}

c. Standards

There are presently no rules in force, either at the Federal or State level, which specify the amount of actual juice which has to be present in a "juice-drink," "drink," or what have you. All the manufacturer has to do is list the ingredients in decreasing order of importance by volume or weight;^{41/} otherwise he can call it about what he wishes. The result, of course, has been a plethora of terms which have little standard meaning.

^{37/}Material for this section was largely gained from correspondence from several processors.

^{38/}There are, however, at least two blends that are undiluted.

^{39/}In the case of the undiluted blends, apple juice is 85% of the apple-grape, and 60% of the apple-cherry.

^{40/}For further discussion of this point with relation to other drink blends, see "Fruit Drinks," Consumer Reports, June 1962, pp. 272-275.

^{41/}Code of Federal Regulations, Title 21, Section 1.10, Item d1.

At present, however, there are several moves on to correct this situation. At the Federal level, the Food and Drug Administration is presently drafting proposals for the establishment of standards.^{42/} At the State level, the Association of Food and Drug Officials of the United States prepared a set of proposed regulations in 1963. Their standards would require the following minimal levels: nectars, 40 percent total juice by weight; juice drinks, 50 percent juice by volume; ades, 25 percent juice; and punches or drinks, 10 percent juice.^{43/}

These proposals were put forth as a model which States might wish to follow. While several States have them or variants under consideration, it is not known that any have adopted them yet. It may be that some are waiting to see what the Food and Drug proposals will look like.

It might be noted that at existing levels of concentration, most of the canned apple blends would not even qualify as "juice drinks" as defined above, and would have to settle for the "ade" category.

IV. FROZEN CONCENTRATED JUICE

A. Processing

1. USDA Processes

Methods for processing concentrated apple juice were developed by the Eastern and Western Regional Research Laboratories of the U. S. Department of Agriculture in the late 1940's.^{44/} They were reported, along with cost estimates, in the early 1950's.^{45/} Since that time only minor changes have been made in the technical phases of the processes. The cost figures,

42/From a discussion with Tom Bellas, Food Standards Branch, Food and Drug Administration, Washington, D. C.

43/"Statement of Policy Concerning Definitions and Standards of Identity for Fruit Juice Beverages," Quarterly Bulletin, Association of Food and Drug Officials of the United States, Volume 27, 1963 (Proceedings Issue) pp. 37-52, especially pp. 39-42.

44/The recovery of essence and its return to the concentrated product to restore flavor, however, appears to have been reported first by workers at the New York Agricultural Experiment Station (D. C. Carpenter and E. C. Smith, "Apple Juice Concentrate," Industrial and Engineering Chemistry, April 1934, pp. 449-454.

45/R. V. Eskew, C. S. Redford, G. W. Macpherson Phillips, High-Density, Full-Flavor Apple Juice Concentrate, U. S. Department of Agriculture, Agricultural Research Service, AIC-315, August 1951 (rerun March 1963), 17 pp. Also, R. K. Eskew, et. al., "Frozen Concentrated Apple Juice," Industrial and Engineering Chemistry, October 1951, pp. 2397-2403.

V. F. Kaufman, C. C. Nimo and L. H. Walker, Frozen Apple-Juice Concentrate: Application of Laboratory Data to Prospective Commercial Operations, U. S. Department of Agriculture, Agricultural Research Service, AIC-293, November 1950, 7 pp.

however, would be expected to change considerably over the period. Supplementary data have recently been prepared by the Western Laboratory comparing the cost of processing, packing, storing and transporting the 3-1 concentrate with single-strength canned juice. Details of their estimates are provided in Table 6.

Table 6. Estimated Costs for Packaging, Storing and Transporting Canned Single-Strength and Frozen Concentrated Apple Juice and Additional Cost for Processing Concentrate^{1/}

<u>Estimated Cost for</u>	<u>Per Ton of Raw Apples^{2/}</u>	
	<u>Canned^{3/}</u>	<u>Frozen^{4/}</u>
Packaging Materials	\$45.20	\$23.60
Storage (5 months)	8.60	6.00
Transportation (Yakima to San Francisco)	12.10	5.20
Additional Processing Cost for Frozen ^{5/}	--	6.50
Total	\$65.90	\$41.30

Notes:

1/Based on prices for carload lots.

2/One ton of raw apples is assumed to yield 1,400 lbs. or 160 gallons of single-strength juice.

3/Single-strength juice is packed in 46-oz. cans, 12 cans per case.

4/Frozen 4-fold concentrate at 44° Brix, packed 6 oz. per can, 48 cans per case; one can of concentrate produces 24 oz. of single-strength juice.

5/Assuming a plant processing three tons of apples per hour, operating 1600 hours per year, and 1963 prices.

Source: "Supplement to AIC-293," U. S. Department of Agriculture, Western Regional Research Laboratory, April 1963, 4 pp.

The estimates indicate that a cost reduction of \$24.60 per ton of apples can be obtained by producing concentrate at Yakima and shipping to a wholesale market in San Francisco.^{46/} The estimator cautions, however, that the increased return that can be obtained with the concentrate will be altered by other factors. On one hand, the concentrate might bring a higher price (per reconstituted unit) because quality is better maintained during storage and marketing. On the other hand, it may well be that its wholesale and retail markups and promotion costs would be considerably higher than

46/If the juices were shipped to Chicago, the saving incurred by the concentrate would be \$36.00 per ton rather than \$24.60.

for canned juice (we shall consider the latter point again in subsequent sections).

2. Sargeant Electronic Process^{47/}

A completely different process, which is now being tested, involves the use of an electronic principle. Anthony Lopez and Daniel Carroll of Virginia Polytechnic Institute describe it this way:

The concentration . . . is based upon producing heat within the mass of the juice by directly exposing it to electronically created high frequency energy. In a vacuum system, this heat causes the evaporation of most of the water contained in the juice.

The evaporation takes place at about 60° F., ". . . thus avoiding flavor damaging effects produced by high temperatures."

In laboratory tests, the juice was concentrated to the point where one part of concentrate reconstitutes with 7.3 parts of water. It was then packed in six-ounce cans. The only important change in the chemical, physical, and organoleptic characteristics was the loss of apple aroma. Although this did not seem to hurt the concentrate's performance compared with the original juice in taste panel studies, concentrate with essence was judged superior. It was suggested, therefore, that essence be restored. For optimum preservation of quality, the concentrate needs to be kept in frozen storage.

A slightly different aspect of this project is the possibility it opens for the production of an apple-grapefruit blend. According to a representative of the Florida firm which uses the process:

These pure fruit concentrates appear to be most compatible. The high vitamin "C" content and the tartness of the grapefruit making its contribution to the blended product and perhaps controlling darkening, the apple concentrate sweetening the grapefruit concentrate . . .

He added that their enthusiasm stemmed from the volume and acceptance of pineapple-grapefruit blends.^{48/} The Florida Citrus Mutual is also interested.^{49/} Research work on the blends is in process at V. P. I.

^{47/}Anthony Lopez and Daniel Carroll, "Optimistic Future for Apple Juice Concentrate," Virginia State Horticultural Society Proceedings, 1964, pp. 85-87; also letter from Dr. Lopez, April 2, 1964. This process was developed for citrus juices by Ralph Sargeant and is used by a citrus processor in Florida. The apple juice was concentrated at this plant. Sargeant and V. P. I. are cooperating in the research.

^{48/}P. T. Swindell, "Promising New Apple Juice Blend," Proceedings, op. cit., pp. 84-85.

^{49/}R. Dale Carlton, "Citrus Growers Profit from Processing," Proceedings, op. cit., pp. 82, 83.

Carroll and Lopez are now working on the apple juice at the pilot plant level. It is anticipated that runs will be made with commercial size equipment to determine product quality under commercial conditions. It is hoped that it will be possible to make cost and marketing studies during the 1964 season. Preliminary study suggests that the product could be retailed at a price of 20¢ per four-ounce can of 7-1 concentrate that reconstitutes to one quart.

Until these studies are made, it is difficult to compare the relative advantages of the Sargeant system and the conventional process - and even then it will be difficult to say unless the juice from the same stock is run through both processes. At this point, however, it appears that the Sargeant process is more efficient in removing water from juice in the 55 to 76 percent soluble solids range.^{50/} Also, under certain conditions it is possible to produce a concentrate from a non-depectinized raw juice. The quality of the product appears to be at least as high as that from other processes.

B. Marketing

Two distinctly different markets exist for concentrated apple juice - the retail and the wholesale. Currently, we have considerably more information on the retail sphere and will discuss it in greater detail.

1. Retail

In evaluating the outlook for frozen concentrated apple juice at retail several years ago, the senior author concluded that "The role of frozen concentrated apple juice is uncertain, but it seems likely that it will not attain popularity unless strongly promoted."^{51/} The statement still appears to hold - as may be reflected in the following sections. We turn first to consideration of 3-1 concentrates, and then to 6-1 concentrates.^{52/}

a. 3-1 Concentrate

At the present time there are three firms known to be producing a 3-1 concentrate for sale at the retail level. One is located in New York, another in Michigan,^{53/} and a third in Washington. Brief comments on their operations and experiences follow.

^{50/}Normally juices jell when concentrated to more than 50% soluble solids; by using the electronic process it has been possible to concentrate to 76% without gelation taking place (letter from Lopez, June 12, 1964).

^{51/}Dalrymple, op. cit. (1960), p. 27.

^{52/}An alternative phrasing sometimes used in the trade is 4-1 (or 4-fold) or 7-1 (7-fold) - to indicate how many volumes of straight juice are used to obtain one volume of concentrate.

^{53/}It is understood that a second Michigan plant is now under consideration.

1) Seneca Grape Juice^{54/}

This New York State-based firm is completing its first season's trail with concentrated apple juice. The firm produces a number of other concentrates and regular strength juices including - obviously - grape juice. Apple juice, then, is just an additional line.

The process is a modification of the USDA essence-recovery method. The juice is fortified with vitamin C and packed in six-ounce cans. A 7-1 concentrate was considered, but it was felt that the marketing disadvantages outweighed the savings in packaging costs, etc.

The firm reports that the technical production problems have been minor; "the major problem has been one of marketing since the product is unknown at the consumer level." To counter this, Seneca concentrated its distribution in the New York area and instituted an intensive advertising program - costing in excess of \$100,000 during the first six months.^{55/} Radio and subway ads have been emphasized. The latter uses the following message: "Real country apple juice in the city? Sure. Because Seneca froze it." This legend surrounds a picture of a frost-covered Seneca can inside a glass gallon jug.

According to the president of the firm, the going retail price has been about two cans for 33¢.^{56/} The price has varied somewhat with special promotions by chains, but a recent one advertised seven cans for \$1.00. Sales have climbed during the season, but at this point it is too early to judge if the product and the promotion have been successful.

2) A. F. Murch^{57/}

The A. F. Murch Co. of Paw Paw, Michigan has produced a frozen apple concentrate for a number of years. It, too, has used the USDA process with an essence-recovery unit. The firm, in fact, produced the 6-1 concentrate that was used in USDA market tests to be described in a subsequent section.

The firm thought, however, that advertising costs for the superconcentrate would be too expensive and limited its commercial efforts to the

^{54/}Based, except where noted, on letters from Arthur S. Wolcott, President, Seneca Grape Juice Corporation, Dundee, March 9, 25, April 13, 1964. The firm recently agreed to lease a new grape and apple processing plant in the Yakima Valley in Washington ("Seneca Plant for Northwest," The Packer, March 14, 1964, p. 27; "Seneca to Lease Plant," The Produce News, April 11, 1964, p. 4).

^{55/}It was planned to step up expenditures considerably during the next six month period.

^{56/}A check of prices by Extension personnel in five New York supermarkets in the New York City area in late March and early April verified this average.

^{57/}Based on a letter from Smith Greig, Extension Specialist in Agricultural Economics, Michigan State University, March 11, 1964.

production of a fortified 3-1 concentrate. This year their run was limited. Retail prices in leading chains on April 1 averaged two cans for 25¢ in Pontiac, Michigan and 15¢ per can in Chicago.^{58/} Promotion has not been extensive.

3) Tree Top^{59/}

Currently, the biggest program with frozen concentrated apple juice is being conducted by a growers cooperative in Washington. Tree Top, a veteran producer of canned juice, invested \$2 million in its plant in Cashmere and started concentrate production during the fall of 1964. It is using the USDA 3-1 concentrate process with an essence-recovery unit. Production capacity is rated at 50,000 gallons of raw juice a day, which reduces to about 40,000 gallons of stripped juice. The concentrate is largely packed in six-ounce cans; it is not vitamin fortified.

The amount of raw material necessary will vary, of course, with the length of the operating season. In December 1963 it was reported that the plant would probably handle over 35,000 tons of apples for the season; full capacity was estimated at 50,000 tons. However, by March the available frozen storage space was filled and the plant closed for the season.^{60/} Although the juice is a blend of Delicious with Winesap or Jonathan, predominant use is being made of Delicious apples - reflecting the heavy production of this variety in Washington.

The manager expects that the concentrating process will enable the cooperative to pay a higher price for apples than is possible with just a single strength juice operation.^{61/} He indicates that savings ". . . would result from substantially less can, cartons, freight, etc." But to return higher prices, the manager stated that it would be necessary to operate about 100 days. "This means," he added, "that growers are going to have to

^{58/}From the survey by State Extension workers noted earlier.

^{59/}This section, unless otherwise noted, is based on the following articles in The Goodfruit Grower (Yakima):

"Bright Future Seen for Concentrate Apple Juice," April 1, 1963,
pp. 1, 13.

"Tree Top to Introduce Concentrate Apple Juice," September 1, 1963,
p. 1.

"Tree Top's New Concentrated Apple Juice Operation Aired," December 1,
1963, pp. 3, 23.

"Tree Top Concentrate Has Unspectacular, But Steady, Response,"
April 1, 1964, p. 5.

Also, Glenn Lorang, "Now . . . Frozen Concentrated Apple Juice," Farm Journal (western edition), February 1964, pp. 42-43.

^{60/}Dick Larson, "Taking the Heat Off the Fresh Market," Western Fruit Grower, May 1964, p. 21.

^{61/}During the 1962-63 season, Tree Top growers apparently received \$45/ton
for apples for regular juice (Lorang, loc. cit.).

make arrangements to have fruit stored . . ." During the winter of 1964 it appeared that the growers would receive \$55/ton for the 1963-64 season.^{62/} Some of this price, however, is retained by the cooperative; during a business meeting on March 17, 1964, the growers authorized the board to retain up to an additional \$10/ton for possible reorganization and expansion. The take-home price to growers was subsequently expected to be about \$40/ton.^{63/}

Tree Top initially placed emphasis on the development of markets in the State of Washington and Southern California. Presumably every chain in Southern California was carrying and advertising the product in November 1963; prices ranged from 20 to 25¢ per can in early April 1964. Subsequently, Northern California, Colorado, Texas, and Florida were added.

As of late March, 1964, the sales response in California and Denver was described as not spectacular, but good and increasing. Whether sufficient markets can be developed as rapidly as production capacity is not clear at this point.

b. 6-1 Concentrate

Although no 6-1 concentrate is presently being marketed at the retail level, a number of market studies have been conducted with it by the Department of Agriculture.^{64/} The most recent study was carried out in 1960 and provides a number of guidelines for those considering entering this field.^{65/}

The test was conducted over a ten-week period from May 9-July 18, 1960 in 23 supermarkets in Fort Wayne, Indiana. The product was packed in a 4.6-ounce can which made one quart on reconstitution.^{66/} It was priced at 20¢ per can or two for 39¢ (i.e., 20¢ per quart). An intensive promotion program was conducted during the first four weeks of the ten-week period. It included media ads and very successful in-store promotion. This was

62/L. P. Batjer, "New Developments in the Northwest Fruit Industry," New York State Horticultural Society Proceedings, 1964, p. 50.

63/Larson, loc. cit. Of this, \$20 is a guaranteed price and the rest is bonus (Lorang, loc. cit.).

64/R. K. Eskew and G. W. Macpherson Phillips, "Apple Juice from Superconcentrate is Preferred," The Glass Packer, March 1954; J. Scott Hunter, Consumer Preference for a 6-1 Apple Juice Concentrate, U. S. Department of Agriculture, Marketing Research Report No. 343, July 1959, 27 pp.

65/E. J. McGrath and Margaret Weidenhamer, The Market Potential for Super-concentrated Apple Juice, U. S. Department of Agriculture, Marketing Research Report No. 582, January 1963, 54 pp., particularly pp. 1-21.

66/Because of the high degree of concentration, the juice does not freeze and can, therefore, be immediately reconstituted. Also, the juice is able to withstand greater temperature fluctuations than 3-1 concentrate.

considered necessary because of the need to get sufficient market penetration of the new product within the test period for interviewing purposes.^{67/}

The sales of the concentrate were reported as promising. The weekly sales rate for each store was nine cases during the promotion period, and two cases during the six-week period following promotion. When comparisons were made with other juices during the promotion period, it was found that the juice ranked fourth (out of 24 items) among frozen concentrates, and second (out of 29) among single strength canned juices. During the post-promotion period, the relative rankings leveled off at seventh among the concentrates and sixth among the canned juices. Even by the last week of the test period, the concentrate was outselling all other apple juices together by a ratio of two to one. The latter is particularly significant because the concentrate does not seem to have adversely affected sales of other apple juices; the concentrate sales were additional sales.

During the last three weeks of the test period, a sample of homemakers in Fort Wayne were interviewed about the juice. Among those who were found to have purchased the product, there were two principle reasons for doing so: (1) it was something new that they wanted to try, (2) they liked the flavor of the sample they tasted in the store. Most of the respondents used the concentrate - like canned apple juice - between meals. Even so, it does not seem to have been substituted for other apple juices, but rather replaced orange and other juices. Consumers who continued to use the juice spoke highly of the flavor, particularly the natural fresh taste. The reconstituting procedure was not noted as inconvenient.

The authors suggested that the retail price of 20¢ per can "... was a price at which a processor could make a fair return and producers should get much more than a salvage price for their apples." In light of present experience with the 3-1 blends, this would seem to be a fair assessment.

Whether or not the 6-1 concentrate would be equally or more favorably received at retail than a 3-1 is not clear. Some processors, as we have seen, have had their doubts. On the other hand, while the initial processing costs may be higher, the smaller bulk of the superconcentrate represents lower packaging, handling, storage and transportation costs. In any case, the authors conclude that "... the new product enjoys a favorable market potential." And, indeed, until someone tried it commercially at retail, we shall know little more.

2. Wholesale and Remanufacture

Unfortunately, there is little information available on the wholesale end of the apple concentrate business. While a number of firms sell

^{67/}It is interesting to note that as a consequence, the expenditure on promotion exceeded the value of the concentrate sales for the test period (Dalrymple, op. cit. 1960, p. 17). A commercial firm - free from the time limitations imposed by the test - could probably have followed a more efficient and less expensive program. Even so, two firms, as we have noted, felt that extra promotion might be needed for the super-concentrate and turned instead to production of the 3-1 concentrate.

concentrate,^{68/} no study has been made of their operations. We do, however, have some limited observations on the superconcentrate.

One upstate New York processor who has gone into the wholesale concentrate business this year is producing a 6-l concentrate with a 70-75° Brix level. The juice is clarified and has essence restored. It is blended and held in a 50,000 gallon tank and sold in tank truck units or in 52 gallon drums. Because of the high level of concentration, refrigeration has not been a problem. While the jam and jelly market has been the traditional wholesale outlet, this firm is finding the juice blend outlet to be an expanding one.

One large market has been provided by the New York State Department of Mental Hygiene. It has been buying fortified apple juice for institutional use since 1958, and this year started purchasing it in the 6-l concentrate form. For the year ending on November 30, 1964 the department purchased the equivalent of about 388,000 gallons of full strength juice. They expect to buy at least as much next year and other departments are reportedly showing some interest.^{69/}

V. CIDER AND FRESH JUICE

A. Processing

1. General

There has been little change in the methods of production of apple cider on farms since 1960. About the only news in this area is that Farmers Bulletin No. 2125, Making and Preserving Apple Cider, has recently been slightly revised and reissued (May 1964, 16 pp.). The main change has to do with sorbate preservation and will be discussed in the next section. Extension workers may obtain a limited number of copies by writing the Federal Extension Service; others should write the Office of Information, U. S. Department of Agriculture, Washington, D. C. 20250.

2. Use of Potassium Sorbate

The use of sorbate as a preservative has been discussed previously by the senior author.^{70/} Within the last couple of years, however, several

^{68/}A list of "Suppliers of Fruit Essences and Concentrates," has been prepared by the Eastern Utilization and Development Division of the Department of Agriculture (CA-E-14 revised, December 1961, 3 pp.). A large share of these products are prepared from cores and peels.

^{69/}Letters from D. M. Dalrymple, New York State Department of Agriculture and Markets, Albany, March 19, 31, 1964. The actual purchase was for 12,859 cases, each containing twelve 46-oz. cans. The price was \$11.95 per case (or approximately 40¢ per reconstituted gallon).

^{70/}Dalrymple, op. cit. (1958), pp. 46, 47; (1959) p. 9.

further reports have been issued pertaining to the use of this "tasteless" preservative.⁷¹/

a. USDA Studies

As a result of work at the Eastern Regional Research Laboratory of the Department of Agriculture, the following recommendations are now made with respect to the use of sorbate:

Add potassium sorbate to the cider as soon as possible after pressing. If the cider is to be stored at room temperature (70° F.), add 0.10 percent by weight of potassium sorbate, the maximum permitted by law. Thus, 1 gallon of a 25-percent solution of potassium sorbate would be sufficient for 250 gallons. Because potassium sorbate is only slightly soluble in cider, add it to the cider slowly and stir vigorously.

Mild refrigeration (50° F. or below) greatly increases the effectiveness of potassium sorbate. At this temperature 0.05 percent of the solution preserves cider for several weeks.⁷²/

Current research at the Laboratory is concerned with the use of Diethyl-pyrocarbonate (DEPC) to reduce the initial bacterial level of the juice and thus increase the effectiveness of the sorbate.⁷³/

b. Ohio Study⁷⁴/

Following examination of a number of preservatives for cider, D. Robert Davis recommended only potassium sorbate. He indicated that sorbate-treated

⁷¹/Preliminary tests of other preservatives were recently reported by J. Y. Do and D. K. Salunkhe, "Effects of Chemical Treatments on Refrigerated Apple Juice," Food Technology, April 1964 (Vol. 18, No. 4), pp. 182-184.

⁷²/Making and Preserving Apple Cider, U. S. Department of Agriculture, Farmers Bulletin No. 2125, slightly revised May 1964, p. 12.

Detail on the experimental work involved with sorbate is provided in the following references from Food Technology:

--E. A. Weaver, J. F. Robinson, and C. H. Hills, "Preservation of Apple Cider with Sodium Sorbate," December 1957 (Vol. XI, No. 12), pp. 667-669.

--E. C. Dryden and C. H. Hills, "Taste Thresholds for Sodium Benzoate and Sodium Sorbate in Apple Cider," February 1959 (Vol. XIII, No. 2), pp. 84-86.

--J. F. Robinson and C. H. Hills, "Preservation of Fruit Products by Sodium Sorbate and Mild Heat," May 1959 (Vol. XIII, No. 5), pp. 251-253.

⁷³/From a discussion with Claude Hills, Eastern Regional Research Laboratory, U. S. Department of Agriculture, Philadelphia, May 19, 1964.

⁷⁴/D. Robert Davis, "Preservatives for Cider," Ohio State Horticultural Society Proceedings, 1962, pp. 163-168, particularly pp. 165-167.

cider (at a 0.05 percent concentration) had an increased shelf life of about five days at 70 to 75° F., and up to nine months at 35° F. Actually the flavor improved with most varieties after six months storage. The sorbate was not, however, effective on cider which had started to act.

While taste panel studies indicated that there is no significant difference in the taste of concentrations of 0.05 percent and 0.10 percent during the first few months, after two months the panel could detect a difference. They did not, however, have a preference for one over another. Davis recommended a concentration of 0.05 percent for filtered cider and 0.075 percent for unfiltered cider. At these levels, the sorbate was about five times as expensive per gallon as sodium benzoate.

According to Davis, sorbate metabolizes to carbon dioxide and water and is the only preservative with this important characteristic. He adds that the Food and Drug Administration feels that it is completely safe.

c. Industry Use^{75/}

Despite the fact that it is tasteless when used in normal concentrations, potassium sorbate is apparently not widely used at present. This is probably related to several reasons: (1) it is still not well known; (2) it is more expensive than benzoate; (3) it is somewhat less effective on unrefrigerated juice than benzoate. The most extensive use at present seems to be by Northeastern growers who make store-door or retail delivery of fresh juice. The effectiveness of the sorbate is enhanced because the growers are offering a high-quality juice which is generally refrigerated. As more such juice is marketed, greater use of sorbate may be expected.

B. Marketing

1. Containers^{76/}

In recent years the paper milk carton has come into widespread use for cider. Because the milk industry - which is the big user - has now swung almost entirely over to plastic-lined cartons, wax-lined cartons are becoming difficult to obtain in many regions. Hence, the grower may find himself using the plastic-lined carton, or none at all.

The plastic-lined cartons have some advantages and disadvantages. The advantages over wax are that: (a) they do not flake, and (b) they do not soak up liquid and become soggy after, say, a week. The biggest problem with the plastic cartons from the grower point of view is in closing them. The heat sealer used for wax cartons will not work on plastic; a more complex unit is necessary. Heretofore, such sealers have been rather expensive for the smaller operator. However, one firm has developed a relatively

^{75/}Based in part on discussions with: Norman French, Orchard Equipment and Supply Co., Bristol, Connecticut, March 27, 1964; Claude Hills, op. cit., May 13, 1964.

^{76/}The authors benefited from a discussion with Norman French, op. cit.

inexpensive model which will sell for about \$400 and be on the market in the fall of 1964. Also, it is possible to convert wax sealers.

Because the plastic-lined cartons have a much longer shelf life than wax, growers who freeze cider find that it is quite possible to freeze, thaw, and sell the juice in the same container. This cannot be done with wax cartons because of the flaking and swelling noted above.

2. Retail Outlets

Some of the more promising markets for chilled fresh apple juice have been the retail store, the dairy route, and vending machines. Some processors have taken advantage of these outlets,⁷⁷ but how many is uncertain.

Retail Stores and Dairy Routes. While a number of northeastern fruit growers continue to find retail stores (served as part of a store-door delivery program) and dairies satisfactory outlets for fresh juice, commercial experience has been somewhat more mixed. One New York firm which tried these outlets went out of business.⁷⁸ Another firm has been selling to dairies since 1962; but the market has not proven to be particularly large when compared to other outlets.⁷⁹ On the other hand, a firm outside of Philadelphia has had successful experience with the weekly vending of juice in glass gallon jugs through a retail route, and preliminary sales through a dairy in the fall of 1963 were very promising. Similarly, a leading processor in British Columbia has found dairy outlets to be of increasing importance (see Section VIII/A for further detail).

Vending Machines: One New York State group which operates a route of 35 refrigerated fruit vending machines has found a good demand for cartoned apple juice. The juice is packed in half-pint cartons. Sales have been great enough in some locations so that two of the four lines of the machine are filled with it. The biggest problem is reported to be leakage and the group is looking for a better container.⁸⁰

⁷⁷/See Dalrymple, op. cit. (1959), pp. 23-24.

⁷⁸/Letter from Cyril G. Small, Associate County Agricultural Agent, Lockport, New York, April 22, 1964 (reportedly the firm did not pay sufficient attention to quality factors and had difficulty in holding its refrigerated unpasteurized juice).

⁷⁹/"New Equipment for Highland Apple Juice, Inc.," The Packer, September 15, 1962, p. 8; letter from William H. Palmer, County Agricultural Agent, Kingston, New York, April 21, 1964.

⁸⁰/Bill Hardy, "Get the Big Bite with your own Vender," Farm Journal (eastern edition), April 1964, p. 37; letter from Fred Mazzacano, Hudson, N. Y., April 30, 1964. Test experiences with vending of cider are noted by Dana G. Dalrymple, Automatic Fruit Vending, Cornell University, Department of Agricultural Economics, A. E. 1008, December 1955, pp. 21, 35.

VI. DEHYDRATED JUICE^{81/}

A process for continuously drying apple juice was developed several years ago by the U. S. Department of Agriculture. The products were reported to have good flavor, color, and aroma; and the keeping qualities at room temperature and at 100° were reported to be excellent.^{82/} A sampling of Connecticut fruit growers conducted by one of the authors in 1959 indicated that they felt that the reconstituted juice had good flavor.^{83/}

Although the military is reported interested in purchasing such a product, it has not yet found a producer. It is not entirely clear why no one has gone into commercial production yet, but it is probably based on a reluctance to tool up for one market. The product, it must be admitted, is of slightly higher cost than the frozen concentrate. Development of other than special markets, therefore, might be an expensive process.^{84/}

Even so, a research and development consultant in Western New York is presently doing further market work with the product. The director of the laboratory indicates that "it is difficult to project what the market potential of this product might be at this early date."^{85/}

VII. BLENDING AND FORTIFICATION

A. Blending of Apple Varieties

With a heavy increase of Red Delicious production in process, particularly in the Northwest, there is increased interest in more extensive use of this variety in juice and cider.

In the past, processors have generally not considered Red Delicious as being good for these purposes because of its low acidity.^{86/} In fact, the

^{81/}The technology of fruit juice dehydration, including apple, has recently been reviewed by J. D. Pointing, W. L. Stanley and M. J. Copley in "Fruit and Vegetable Juices," Food Dehydration - Products and Technology (Vol. 2), (ed. by Van Arsdel and Copley), Avi Publishing Co., Westport, 1964, pp. 508-561.

^{82/}V. A. Turkot, R. K. Eskew and N. C. Aceto, "A Continuous Process for Dehydrating Fruit Juices," Food Technology, December 1956 (Vol. X, No. 12), pp. 604-606. Also see V. A. Turkot, H. I. Sinnamon, R. K. Eskew and G. W. Macpherson Phillips, "Storage Behavior of Powdered Apple and Grape Juice Products," Food Technology, October 1955 (Vol. IX, No. 10), pp. 506-509.

^{83/}Dalrymple, op. cit. (1959), p. 15.

^{84/}From a discussion with R. K. Eskew, Eastern Regional Research Laboratory, U. S. Department of Agriculture, May 13, 1964.

^{85/}Letter from W. N. Falcon, Albion Laboratories, Albion, New York, March 10, 1964.

^{86/}Dalrymple, op. cit. (1958), pp. 28-29.

largest juice processor in Canada reports that they do not think that Delicious by itself produces a favorable product and have limited the quantity that they use, even though it is surplus in their area.⁸⁷ On the other hand, the largest processor in the Pacific Northwest has very successfully marketed a blend which contains well over half Delicious for a number of years.⁸⁸ Thus, the question of what proportion of Delicious can be used appears to be an unsettled one at the commercial level.

There is, however, one little-known study which casts some helpful light on the subject at the consumer level. During the 1950-51 season, the Department of Agriculture, in conjunction with the Washington State Apple Commission and Washington State College conducted taste tests with frozen concentrated apple juices made of different varietal and acidity combinations.

First, a set of taste panel discrimination tests were conducted at Washington State College.

From these discrimination tests, it was learned that the panels could not discriminate between different varietal blends of approximately equal acidity. Furthermore, those in the test had difficulty in discriminating between the 100 percent Delicious juices and the blended juices when they were of equal acidity. The findings indicated that people are more likely to detect differences in acidity in these juices than they are in variety differences at the same level of acidity.⁸⁹

Following this stage, three juices were selected for consumer testing in the San Francisco area. They were: (1) a 100 percent Delicious juice with a natural acidity of about 0.2 percent; (2) a 100 percent Delicious juice adjusted to an acid level of 0.5 percent by the addition of citric acid; and (3) a blend of about 50 percent Delicious, 20 percent Jonathan, 20 percent Winesap, and 10 percent Rome with a natural acidity of about 0.5 percent. The taste tests were conducted in 308 households, representing 690 individuals over the age of ten. Results indicated the following relative scores: the four-variety blend, 100.0; Delicious adjusted to 0.4 percent acidity, 99.2; Delicious of 0.2 percent acidity, 96.1. Thus, while

⁸⁷/Letter from Ian F. Greenwood, Assistant General Manager, Sun-Rype Products, Ltd., Kelowna, B. C., April 17, 27, June 12, 1964. Greenwood notes that it is possible to use more Delicious early in the season when the acidity level is higher. Canadian law requires an acid level of 0.35% in juice.

⁸⁸/Note from A. M. Neubert, U. S. Fruit and Vegetable Products Laboratory, Prosser, Washington, June 2, 1964.

⁸⁹/Summarized in New Concentrated Apple Juice: Its Appeal to Consumers, U. S. Department of Agriculture, Bureau of Agricultural Economics, November, 1951, pp. 1-2 (out of print). The bulletin indicated that a detailed report was in preparation; according to A. H. Harrington it was prepared but not published (phone conversation, June 8, 1964).

the blend was preferred, the Delicious juice with added citric acid was not far behind; the natural Delicious juice was least preferred. A separate record of the spontaneous remarks of the participants pointed to the same ordering.^{90/}

While one should not generalize too far on the basis of one test conducted in one area, the results do suggest some interesting lines of thought. The most obvious is that if a juice is to be made largely out of Delicious apples, it might be worthwhile to consider adding citric or malic acid to bring it up to an acidity level comparable to a blend. And by adding acid, it would be possible to standardize the level. On the other hand, the added acid would have to be declared on the label and possibly would detract from the sales value.^{91/} Further investigation of this area - particularly with respect to canned single strength juice - might prove to be most valuable.

B. Blending with Other Fruit Juices

Studies of the blending of apple juice with other fruit juices have been conducted at Ohio State University and in England during the last several years.

1. Ohio State Study

In taste panel studies conducted in Ohio in 1960, five blends were evaluated for flavor: apple-grape, apple-cherry, apple-strawberry, apple-lemon, and apple-lime. Several different proportions were tested, along with three different dilutions. Both pasteurized and fresh blends were evaluated. The results are presented in detail in Table 7.^{92/}

It was found that in every case the most preferred blend (compared with other blends and straight apple juice) was with strawberry juice. Among the pasteurized juices, the blend involving 25 percent strawberry juice appeared to be best received; even dilution by a half with water did not seem to diminish its popularity. Among the fresh juices, the blend with ten percent strawberry appeared to have an edge; in the case of either

90/Consumer Preferences for Selected Frozen Concentrated Apple Juices, U. S. Department of Agriculture, Bureau of Agricultural Economics, June 1951, 21 pp. (out of print). One exception to this general pattern was provided by the children between 10 and 20 (12% of the sample) who preferred the sweeter Delicious juice.

91/Also, some packers pride themselves on putting up a pure juice and would be reluctant to add anything to the product. In Canada, packers are not allowed to add any acid (Greenwood, op. cit., June 12).

92/D. R. Davis, Quality Evaluation of Fruit Juice Blends, Ohio Agricultural Experiment Station, Department of Horticulture, Mimeo. No. 267, February 1962, pp. 17-18. This report also contains detailed information on pH, total acids, soluble solids, and sugar/acid ratio. Statistical analyses, however, were apparently not run to indicate significant differences.

Table 7. Flavor Scores of Apple Juice Blends^{1/}
Wooster, Ohio, 1960

		Dilution Factor ^{2/}		
		0	$\frac{1}{4}$	$\frac{1}{2}$
I. Pasteurized				
Apple		6.6		
Apple-Grape				
50 : 50		5.6	5.9	4.2
75 : 25		6.2	5.8	4.6
Apple-Cherry				
50 : 50		6.0	5.7	5.8
75 : 25		6.7*	4.6	4.5
90 : 10		7.0*	5.6	5.6
Apple-Strawberry				
75 : 25		7.3*	6.8*	7.2*
90 : 10		7.1*	5.9	4.7
Apple-Lemon				
95 : 5		6.9*	5.7	4.3
98 : 2		6.5	6.4	4.9
II. Fresh				
Apple		6.7		
Apple-Grape				
50 : 50		7.0*	5.9	5.3
75 : 25		7.0*	6.6	5.7
Apple-Cherry				
50 : 50		6.2	5.9	4.7
75 : 25		5.1	5.4	3.6
90 : 10		6.4	6.4	3.2
Apple-Strawberry				
75 : 25		7.7*	7.4*	5.7
90 : 10		7.9*	7.6*	5.7
Apple-Lemon				
95 : 5		5.1	6.3	3.0
98 : 2		6.6	5.7	3.8

Notes:

1/Range: from 1 (poor) to 9 (excellent).

2/Respectively: no dilution with water, 25% water added, 50% water added (technically, this was measured in terms of soluble solids).

*Superior to regular apple juice.

Source: D. R. Davis, Quality Evaluation of Fruit Juice Blends, Ohio Agricultural Experiment Station, Department of Horticulture, Mimeo. No. 267, February 1962, pp. 17-18.

proportion the popularity dropped off sharply when diluted with one half water.^{93/}

The blends with grape and cherry juice showed variable results. An undiluted, unpasteurized blend with grape juice was preferred to regular apple juice; others were not. On the other hand, two of the undiluted but pasteurized blends with cherry juice were preferred (if but slightly) over the regular apple juice.

The blends with lemon and lime juice were not so well received - the lime juice combination faring particularly poorly.^{94/}

In general, it was interesting to note how the flavor scores for the most part dropped off fairly sharply as the amount of dilution increased up to one half. With nearly all of the fruit juice drink blends on the market containing more than half water it is apparent that less than the most desirable concentration may be reaching the consumer.^{95/}

In further tests conducted among growers at annual meetings of the Ohio State Horticultural Society in 1960 and 1961, it was found that compared to regular fresh apple juice, the blend with strawberries was somewhat preferred, while there was a marked preference for a blend involving one orange peel per bushel of apples. A blend involving 10 percent peach juice was not well received.^{96/}

Future work will involve the blending of cider with peel oil from various citrus fruits.^{97/}

2. English Study^{98/}

In a study conducted by the Bureau of Commercial Research for the Horticultural Marketing Council in England, four canned apple-fruit juice blends

93/A more detailed evaluation of preferences for this blend by age groups is presented by J. F. Gallander and H. L. Stammer in "Cider-Strawberry Fruit Juice Blend," Research Progress Reports, 1963, Ohio Agricultural Experiment Station, Department of Horticulture, Mimeo. No. 300, pp. 29, 30.

94/As noted earlier, an apple-grapefruit blend is being considered by a Virginia-Florida group (Section IV/A/2).

95/Whether it would pay processors to increase the concentration, however, is of course not indicated by this study.

96/D. Robert Davis, "Fruit Juice Blends Offer a Promising New Field for Apple Cider," Ohio Farm and Home Research, September- October 1962. This publication also presents a summary of the Ohio work noted previously.

97/Letter from James F. Gallander, Ohio Agricultural Experiment Station, Department of Horticulture, March 24, 1964.

98/The Future Production and Marketing of Apple Juice in U. K., Horticultural Marketing Council, Technical and Economic Reports No. 7, January 1963, pp. 5-8, 37-40.

were tested. They were: apple-apricot, apple-raspberry, apple-pineapple and apple-orange. The first three were commercial products. In addition, canned orange and apple juices were used as controls. A sample of 216 households was selected for each blend.⁹⁹ The results are indicated in Table 8.

Table 8. Acceptability Ratings of English Canned Fruit Juice Blends

<u>Blend</u>	<u>Rating</u>
Apple-Apricot*	2.27
Apple-Orange*	2.04
Apple-Pineapple*	2.02
Apple-Raspberry	1.40
<hr/>	
Opalescent apple**	1.60
Orange	1.18

*A commercial brand (Fruit Products, Ltd.).

**A carbonated apple juice was given a rating of 2.04.

Source: The Future Production and Marketing of Apple Juice in U. K.,
Horticultural Marketing Council, Technical and Economic Reports
No. 7, January 1963, pp. 5, 37.

For a significant difference to exist, one rating needs to exceed another by a value of 0.5. Thus, we can see that the apple-apricot blend was significantly preferred to both apple and orange juice. The ratings for the apple-orange and apple-pineapple fell slightly below the required level when compared to regular apple juice, but significantly exceeded the rating for orange juice.

These results appear to be in line with tests and commercial experience with similar blends.¹⁰⁰ Even so, of the blends tested in the above study, only the apple-raspberry is presently produced commercially in the United States (aside from baby-juice blends).

C. Fortification

The material on vitamin fortification centers about a retail survey of the extent to which it is done, and some limited data on fortified baby juice.

⁹⁹/The sampling and testing procedure was somewhat different from that which would normally be used in this country.

¹⁰⁰/See Dalrymple, op. cit., (1958) pp. 58-59, (1959) pp. 16-20. Also, Section VIII/A of this report.

1. Retail Survey

As a part of the retail survey of apple juice and blends noted earlier, State workers were asked to note whether juice was fortified. Among the regular canned juices it was found that only two packers of any size were adding vitamin C - and this was to quart-sized cans only.¹⁰¹ The situation was a little different among the juice drink blends. All but one of the apple-grape blends were fortified: two packers were adding vitamin C and three were adding vitamins B₁ and B₂.¹⁰² The situation among the other blends was variable, but where fortification was done, vitamin C was added. Included in this latter group were: an apple-cranberry blend, the two apple-cherry-berry blends, a five-fruit breakfast drink,¹⁰³ and a fruit punch.

The sharp difference in fortification practices between the regular juice and the drink blends is at first a bit surprising. But further thought suggests that the blends may well reach more into the breakfast or citrus juice market than do the pure apple juices, and therefore have to be fortified in order to compete with other blends containing citrus juices. Also, since the blends have a lot of added water, the manufacturers may feel that they have to add something extra in order to compete with the pure juices.

2. Baby Food Juice

Survey of retail stores suggests that there is a large number of fortified blends available in infant-sized containers. Generally the amount of ascorbic acid added is 50 mgm. per 100 cc.

One of the few available studies on this product relates to its acceptance and tolerance by infants.¹⁰⁴ Over a two-year period, starting in January 1960, two pediatricians in Winchester prescribed fortified apple

¹⁰¹/By comparison, over 90% of the Canadian juice is fortified. As previously noted, two out of the three manufacturers of concentrated juice add vitamin C.

¹⁰²/It is at first not clear why vitamin B is added instead of C, for both canned apple and grape juice are relatively much lower in C than they are in B (see Dalrymple, *op. cit.*, 1958, p. 89). Correspondence from one processor indicates, however, that vitamin C has a leaching effect on the pigments found in dark colored juices. This effect, in turn, can cause some side reactions which may change the flavor and color of the product. The B vitamins are reported more stable. Another large processor reports that B is added because it is assumed that the drink is used as an afternoon-evening beverage, rather than at breakfast.

¹⁰³/Vitamin A was also added to this drink.

¹⁰⁴/William D. Way and Joseph M. Damron, "Supplementary Juice for Infants," *Virginia Medical Monthly*, March 1963, pp. 111-116.

juice and orange juice for a group of 379 infants between the ages of three and six weeks. They summarized their findings as follows:

The conclusions drawn from the statistical study on the observations would seem to indicate that the non-citrus juice (apple) was more readily accepted by the infants than the citrus juice (orange). In addition, those infants fed the noncitrus juice exhibited less disorders of rash, colic, excessive flatus, change in stools and spitting than those who received the citrus juice.^{105/}

Just how much fortified apple juice baby food there is on the market is unclear. Data from the Michigan State Consumer Panel suggest that from 1954-57 only about 2 percent of all juice and cider purchases (or about 0.05 lb.) were in baby food form. The price per pound, however, was nearly three times as high as for regular juice so that the total expenditure was about 8 percent of the total spent on juice and cider.^{106/}

VIII. DEVELOPMENTS IN OTHER COUNTRIES

A. Canada^{107/}

1. British Columbia

Apple juice production in British Columbia during the 1963 season, in response to a bumper crop, reached record levels. The pack consisted of both clarified and opalescent juices. Blended products continued to include apple-lime, and apple-apricot; the latter is still increasing in popularity.^{108/}

The largest packer of apple juice in British Columbia - and in Canada - indicates that 1963-64 was the biggest year in their history. Demand seemed to be stronger for the clarified than for the opalescent juice - partly because they were able to export substantial quantities of the former to the West Coast of the U. S. Within the last few years the firm has found a good market for a variety pack of six 6-ounce cans of juices and nectars; the retail price has been 59¢ per unit. All juices and nectars are fortified with vitamin C.

^{105/}Ibid., p. 116.

^{106/}Dalrymple, op. cit. (1961), pp. 3-5.

^{107/}Also see Section III/A/1.

^{108/}Based on letter from J. A. Kitson, Research Station, Canada Department of Agriculture, Summerland, B. C., April 6, 1964. Canadian experience with these blends was previously reported by Dalrymple, op. cit. (1959), pp. 16, 18.

The same firm has also moved into the marketing of apple juice in milk cartons. Freshly pressed and filtered juice is immediately chilled to 40° and trucked some 300 miles to a large dairy in Vancouver in stainless steel tank trucks. There it is pasteurized, chilled, and packaged. A 40-ounce carton is used and the fortified juice has been retailing for 31¢ in the supermarkets and 33¢ on the milk routes. The latter are by far the largest outlet. The firm is currently experimenting with an 8-ounce cream size carton for use in cafeterias, etc.

As a result of these efforts, the firm estimates that per capita apple juice consumption in their market is second only to Switzerland in the world. And they feel that if they continue to pack only top quality juices it will continue to increase.^{109/}

2. Nova Scotia^{110/}

A concentrated apple juice has been produced for a number of years by a Nova Scotian firm. Three-bed Buchner-Buyer Swiss rotary presses are used. The juice is flash evaporated to one-sixth its original volume. An essence-recovery unit is used. The concentrate is in some cases used to manufacture apple drink, apple pop, and apple wine. To give the pop extra tang, citric or malic acid is added; it is reported that Mexico and South America are large consumers.

B. England^{111/}

In England, the Horticultural Marketing Council commissioned an extensive study of the future production and marketing of apple juice in the United Kingdom. The summary report of this study was published in January 1963. It included the following conclusions:

The pure fruit juice market in U. K. is relatively small and is not growing at a notably high rate . . .

. . . the developments of apple drinks will require large scale marketing efforts . . .

It appears that the new products could best be developed by businesses which already have established production and distribution facilities, and the resources to promote the products.

Grower . . . efforts would probably be better directed to organizing the supply of apples in ways appropriate to the needs of the processing industry.

^{109/}Based on letters from Ian F. Greenwood, Assistant General Manager, Sun-Rype Products Ltd., Kelowna, B. C., April 17, 27, 1964.

^{110/}Peter Butland, "Concentrated Apple Juice and Esters - Versatile Products," Canadian Food Industries, January 1960, pp. 26-27.

^{111/}The Future Production . . . op. cit., p. 34.

Seasonal supply fluctuations could be dealt with in several ways, but most obviously by the installation of concentration and storage plant by processors.

The Council considers that the prospects of a growing apple juice industry are bright in the longer run . . . The dominant factor is the demand for apple juice and its responsiveness to promotion and marketing, and not the simple existence of surplus apples.

C. Switzerland¹¹²/

A general survey of the Swiss apple juice industry was also recently made by the Economist Intelligence Unit for the Horticultural Marketing Council. Of the several items covered, the following may be of particular interest:

--In 1960, production of juice and cider totaled about 17.8 million gallons. More could have been produced if it could have been marketed.

--Apple juice concentrates are relatively new, and most of the product is used to blend ("stretch") with pure apple juice, particularly in the summer when stocks of juice are running low.

--Some apple essence ("aroma") is produced and 11 tons were exported in 1960.

--Retail prices are fixed in accordance with harvest prospects and manufacturing costs. The retail margin averages about 30 percent.

--Some blends are marketed, the most usual being with orange, grapefruit, lemon, or raspberry juice.

IX. CONCLUDING REMARKS

A. Effect of Florida Freeze

In evaluating the overall market position of apple juice, some have felt that the Florida freeze may have provided a helpful boost. It is possible that there was some beneficial effect, but it probably did not occur in quite the way that was expected.

The reasons for this lie in the form in which apple and orange juice are consumed. Orange juice is largely marketed as a frozen concentrate, while apple juice is mainly sold in canned form or as a fresh product ("chilled"). This is shown in Table 9.

The "chilled" apple and orange products are substantially different. The chilled classification adopted for apples (for convenience) actually includes all non-canned and non-pasteurized juices; this means it largely represents the fresh apple juice and cider produced and sold by farm and

112/Ibid., pp. 8-17.

Table 9. Estimated Per Capita Juice Consumption
United States, 1959

<u>Form</u>	<u>Apple</u>	<u>Orange</u>
Canned	0.99 lb.	3.25 lb.
Frozen	*	13.79
Chilled	1.08**	1.87
Total	2.07 lb.	18.91 lb.

* Negligible.

** Fresh juice and cider.

Source: Dana G. Dalrymple, Market Potentials for Apple Juice and Cider, Michigan State University, Department of Agricultural Economics, Ag. Econ. 804, December 1960, p. 7.

local cider mills in glass jugs and, to a lesser extent, paper cartons. The chilled orange juice is, for the most part, quite a different product. It is put up by commercial firms in Florida, often treated with heat or chemicals, refrigerated and sold in one or two-quart paper cartons or glass bottles in retail stores.^{113/}

On the other hand, the forms of the canned and frozen products are similar -- they are packed in similar containers and sold in the same areas in retail stores. The quantity of frozen apple juice on the retail market, however, has been practically nil and even now is very small in volume terms. This means that the main beneficiary of high citrus prices might be expected to be canned apple juice.

Yet this projected influence is not as clear-cut as might be expected because of the different uses made of the juices. Apple juice is primarily used as a meal snack, while orange juice finds its greatest use at breakfast.^{114/} Again, because of the volumes included, this is primarily of concern for the canned juices, but USDA researchers found the same general relationships to hold for frozen concentrate.^{115/} Thus, we find

^{113/}For further detail, see Dana G. Dalrymple, "Fresh Chilled Fruit Juice," New York State Horticultural Society Proceedings, 1958, pp. 214-219. The only overlap would come when both are sold at the same time in refrigerated display racks in retail markets; and there is little of this.

^{114/}Dalrymple, op. cit. (1958), p. 15.

^{115/}McGrath and Weidenhamer, op. cit., pp. 17, 18.

the amount of direct overlap limited to apple juice that is used for breakfast and orange juice that is used for snacks.^{116/}

B. Relationship of Blends

If the direct effect of higher citrus juice prices on apple juice and cider is less than might have at first been expected, there is another effect which should not be discounted. This is the effect citrus prices may have had on stimulating the blend market. In 1959 there were only a couple of apple-grape or apple-prune blends on the market in any quantity. Today, as we have noted, there are around ten blends of apple juice, not to mention a wide variety of other blends. Many of these blends, as we have also indicated, are fortified. Some are directly aimed at the breakfast market, while others may find more general use. There would - to be sure - have been some growth in this category without the freeze, but the higher citrus prices likely aided the proliferation of blends.

While the biggest immediate effect may be a certain substitution for citrus juices, some have wondered if the apple blends have not also substituted for regular apple juice. This could be of concern because of the relatively low level of actual juice in the drink blends. It is not clear whether this has happened. We can only say that if it has, it has not stopped the growth of production and consumption of canned apple juice; it may, of course, have cut the rate of growth down. If on the other hand, the juice drinks are being substituted for soft drinks, the net effect may be positive. This would be an area well worth further study.

In the future we will probably see further expansion in the variety and volume of blends. It is to be hoped that regulations will soon be adopted which will provide some degree of uniformity of products.

C. Outlook for Juice and Cider

Although blends may be expected to grow in popularity, the unblended forms of juice and cider should not be overlooked. There seems to be little reason to expect them to do other than expand. Indeed, with sharply increased apple production in the offing, an added amount of juice and cider will likely be forced on the market. This may well not enhance the price situation, unless further attention is given to improvement of product, marketing and promotion.

An additional problem could be created because of the increased production of Red Delicious. While many processors feel that it is too low in acid to produce a good juice, we have noted that some limited testing has suggested that addition of malic or citric acid to the juice may improve its acceptability by consumers. Unfortunately, there is too little

^{116/}Despite the limited direct overlap, however, the purchases of concentrated apple juice in the USDA study in Fort Wayne were found to be mostly at the expense of orange juice (Ibid., p. 32).

information on this subject to make any recommendations at this point. Further tests in various parts of the country would seem to be very much in order.

In terms of reaching new customers, and providing new markets, the frozen concentrate would seem to hold particular promise - but only as we have suggested, if adequate promotion programs are followed. Also, it should be remembered that the apple concentrate introduced this season encountered higher than average citrus prices. As citrus production increases - and it is expected to do so sharply in the near future - citrus prices will drop and their competitive strength will increase. But before this happens, apple juice concentrate may well have found some niche for itself.

On the other hand, fresh juice or cider faces less potential competition from citrus. But here it will be especially necessary to carry out an improved program of production and marketing if any substantial increase in demand is to be expected.

The overall prospect, then, for apple juice and cider might be summed up as one of cautious optimism.

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